1,102,338

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Automatic Gas Lighters

I, SHINJIRO KOBAYASHI, a Japanese Citizen, of No. 1—1085, Koiwa-cho, Edogawaku, Tokyo, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in or relating to gas lighters especially suitable for igniting cigarettes or the like.

Conventional gas lighters are provided with manually operable means such as push buttons for opening a gas valve as well as for causing sparkling, the heating of an electric resistant element, or the like.

According to the present invention there is provided a gas lighter comprising a liquefied gas fuel reservoir, a burner nozzle connected with said reservoir, an electric heater or spark electrodes mounted in the proximity of the outlet opening of said nozzle, means for closing and opening said nozzle to prevent or allow flow of fuel therethrough, a detector electrically connected with a detector circuit for sensing a foreign body such as a cigarette when it is brought to a position in close proximity to said detector, and an operating circuit electrically connected with said detector circuit for opening said nozzle when said detector circuit is influenced in the manner above described.

These and further features and advantages of this invention will become more clear from the following detailed description of several preferred embodiments of the invention given by way of example of the invention only and with reference to the accompanying drawings.

In the drawings:

Fig. 1 is a schematic diagram illustrative of an electronic circuit used in an embodiment of this invention, a predominant feature of the circuit being the provision of electrostatic means for detecting the close proximity of a cigarette or the like body;

Fig. 2 is a schematic vertical sectional view of an automatic gas lighter embodying the circuit shown in Fig. 1;

Fig. 3 is a schematic diagram illustrative of an alternative electronic circuit instead of that shown in Fig. 1, the circuit being provided with a photoelectric detector;

Fig. 4 is a schematic vertical section of another embodiment of the invention, embodying the circuit shown in Fig. 3;

Fig. 5*a* is a heating circuit employing a heatable element;

Fig. 5*b* is a modified circuit employing a couple of discharge electrodes instead of the heatable element;

Fig. 6 is a further modified circuit containing rectifier means fed from a commercial A.C. current source; and

Fig. 7 is a another modified circuit containing a musical box as well as a plurality of colored signal lamps.

In the drawings, especially in Figs. 1 and 2, 11 represents a detector made of a conductive metal, for instance iron, copper or the like which is electrically connected to one end and one electrode, respectively, of a coil 12 and condenser 13. The opposite end of the coil and the other electrode of said condenser, are electrically connected through a junction point 100, and a second condenser 14, to the base electrode of a transistor 15. 16 denotes a resistor and 17 and 18 represent a variable resistor and a battery, respectively. The aforementioned circuit elements 11 to 18 constitute in combination a detector and oscillator circuit which is designed to oscillate normally at a constant frequency, for instance 10 mega-cycles per second.

When an outside body having a high dielectric coefficient, for example a cigarette,

[*Price 4s. 6d.*]

Price 75p

is brought to a position in close proximity to the detector 11, the capacitance between the latter and the means will become larger and thereby the capacitance of the oscillator circuit will be increased thus causing the circuit to oscillate at a new frequency. This change in frequency of oscillation is arranged to cause a fall in the voltage at the emitter of the transistor 15, by virtue of the fact that the latter is connected to a filter composed of a resistor 19 and a condenser 20. The change in the voltage at the emitter electrode of the transistor 15 causes a blassing current to flow therefrom to a power transistor 21 electrically connected therewith. The collector current of the transistor 21 will thus increase to a degree sufficient to cause a contact of a relay 22 electrically connected with the collector electrode of the transistor 21 to shift from its open position as shown by a full line to in Fig. 1 to its closed position illustrated by a broken line in Fig. 1.

A valve-operating circuit, comprising an electromagnet 23, a safety switch 24, a current source 25 and the relay 22 is connected as shown. An ignitor circuit comprises an electrically heatable element 26, the safety switch 24, the current source 25 and the relay 22. The said two circuits will be called in common hereinafter a "lighter-operating circuit". When the contact of relay 22 is closed in the aforementioned way, the valve-operating and ignitor circuits are also closed, whereby a burner valve 101, Fig. 2, and heater 26 are energized to operate, as will be more fully described with reference to Fig. 2.

When the cigarette is removed from the acting zone of the detector 11, the capacitance of the detector and oscillator circuit will be restored to the normal value so that the detector circuit returns to its original frequency of oscillation ready for further detection. The relay 22 is thus de-energized again to open its relay contact which is thus transferred back to its position shown by a full line in Fig. 1. In this way, the lighter-operating circuit is de-energized to its non-operating position.

In the aforementioned embodiment, a Hartley circuit is employed for part of the detector circuit. Other known LC-oscillator circuits may be employed with equal results, as will be easily understood by those skilled in the art. Instead, a known RC-oscillator circuit may be adopted for the same purpose.

In the embodiment shown in Fig. 2, numeral 27 represents the casing of the lighter which is substantially in the form of a deep and hollow dish in order to attain a specific design effect. A fuel reservoir 28 containing therein a quantity of liquefied gas, such as propane, butane or the like, is mounted rigidly in the interior of the casing 27 and is provided at its bottom with a conventional fuel recharge valve 29, only schematically shown. 30 denotes a conventional burner nozzle which is slidably arranged relative to a valve body fixedly mounted on top of the reservoir 28. Although not shown, the valve body is provided therein with a conventional burner valve which is kept in fluid connection with the lower end of nozzle 30. The nozzle is urged downwardly to a closed position by a spring mounted in the valve body 101. The detector 11 is formed into a cowling and fixedly attached through the intermediary of an insulator socket 31 to the upper wall of the casing 27. The said cowling acts as a wind protector for the gaseous fuel issuing from the upper end 34 of the nozzle 30. Numeral 32 denotes in a simplified block form the aforementioned detector and oscillator circuit, excluding the detector 11. The relay 22 is shown in this figure only schematically in a block form. In practice, the electro magnet 23 is shaped as a disc and fixedly mounted on casing 27 or fuel reservoir 28. A disc plate 33 is arranged normally at a small distance from magnet 23 and in parallel relation therewith, said nozzle being fixedly attached to the disc plate 33 which is thus movably mounted.

When the lighter-operating circuit is energized in the aforementioned way upon closure of the contact of relay 22, the electro-magnet 23 is energized and thus attracts the mating disc 33, whereby nozzle 30 is moved upwardly allowing the gasified fuel to issue in the form of gas jet from nozzle outlet opening 34. At the same time, the igniter circuit is also energized so as to heat up the element 26 for igniting the gas jet. In this way, a cigarette or the like combustible body, now positioned in close proximity to the detector cowling 11, is ignited.

The safety switch 24 is inserted, as shown in Fig. 1, between current source 25 and the valve-operating circuit and the igniting circuit and is constituted, in practice, by a gravity switch comprising an insulator board *l*, a movable gravity-operated contact *m* pivotably mounted thereon and a stationary contact *n* rigidly mounted on the board. Under normal conditions, movable contact *m* depends substantially vertically so as to establish a conducting relation with the mating stationary contact *n*. Under abnormal conditions, wherein the lighter is brought into an inclined position by some cause or other, the movable contact is urged by gravity action so as to disengage from the mating contact and thus the lighter operating circuit is interrupted from current source 25. Thus, even if some foreign body should occupy a position in close proximity to the detector, the opening of the fuel outlet from the nozzle, as well as the heating-up of the element 26 are positively prevented from taking place, whereby unintentional fire hazard is avoided.

When a cigarette is ignited under normal conditions and in the aforementioned manner and withdrawn from close proximity to the detector, the oscillator circuit will again return to its original frequency of oscillation whereby the relay 22 is brought to its off-position, as denoted by a full line in Fig. 1, and the movable contact disc 33 will be moved again to its lowered position. Upon downward movement of the movable disc 33 together with the nozzle 30, the burner valve is caused to close.

It will be easily understood that the transistor adopted for the control of the relay 22 may be replaced by a vacuum tube, discharge tube, thyratron or the like. The gravity-operated safety switch may also be replaced by other conventional means.

In the modified circuit shown in Fig. 3, a photoelectric detector 11*a* is employed instead of the capacitance-depending detector shown in Figs. 1 and 2. This detector is preferably a photo-transistor and impressed with a voltage the sign of which may be reversed compared with the voltage impressed on a transistor when used as a rectifier.

In the circuit shown in Fig. 3, there are provided transistors 36, 37, 41 and 44 arranged in four stages after the detector photo-transistor 11*a*. The first stage transistor 36 is arranged to cooperate with a thermistor 35 such that with increase of the ambient temperature the resistance value of the thermistor 35 will be correspondingly reduced. With this arrangement, increase in current from the transistor 36 with increase in temperature will be shunted off from the next stage transistor 37 so that the latter is subjected to practically no influence caused by occasional fluctuation of ambient temperature. The transistor 37 acts as an amplifier, as will be easily understood by those skilled in the art. Resistors 38 and 39 are arranged as shown for controlling the collector-emitter voltage and current of the two transistors 36 and 37. Variable thermistor 40 and transistor 41 are provided and arranged for the same purpose as was described above in connection with the thermistor 35 and the transistor 36.

Numeral 42 denotes a constant voltage diode and 43 represents a resistor arranged for controlling the collector voltage and current of transistor 41. Resistors 45 and 46 are arranged for the same purpose in connection with an amplifier transistor 44.

Resistors 47 and 48 are arranged to act as voltage dividers for controlling the emitter voltage of transistor 44. As the current source, batteries may be used as before. In the present embodiment, however, commercial A.C. current source is utilized. More specifically, such current, for instance A.C. 100 volts, is supplied to the primary winding of transformer 49 and a lower voltage, say 12 volts is taken from the secondary winding and fed to a full-wave rectifier of bridge type, comprising four diode elements 50, 51, 52 and 53. The rectified current is fed through condenser 54 to the circuit described above.

On the other hand, current is also taken from the secondary of the transformer and fed to a lamp 55, projecting light beams through condenser lenses 61 and 62 (Fig. 4 upon the photoelectric detector element 11*a* in the form of a photo-transistor in this case. Electromotive force is thus induced in the photo-transistor and the generated current is amplified by amplifiers 37 and 44, and energises a relay coil 22*a* connected between the collector and of the final stage transistor 44 and the DC supply. It will be easily understood that the relay coil 22*a* is constantly energized under these conditions and keeps its contact open, as indicated by the corresponding full line in Fig. 3. This contact is connected in a lighter operating circuit (not shown) similar to that described hereinbefore with reference to Fig. 1.

Now assuming that a user brings a cigarette to the light passage between the condensing lenses 61 and 62, the beam received by the photo-transistor is thereby considerably reduced or interrupted, the relay coil 22*a* is de-energized and its contact is thus caused to close, as indicated in Fig. 3 by a broken line. In this way, the lighter-operating circuit is activated and gaseous fuel is delivered and ignited for the ignition of the approaching cigarette.

As the photoelectric detector, a CdS-element, a photo-voltaic cell, a photoelectric cell or like photoelectric conversion means of conventional design may replace the photo-transistor 11*a*.

In Fig. 4, an automatic gas lighter embodying the circuit shown in Fig. 3 is schematically illustrated.

In this embodiment, 27*a* represents a substantially closed casing of the lighter, having a central and upper opening 56 as defined by a hollow wind shield 57 shaped as a cowling fixedly attached to the upper wall of the casing. A fuel reservoir 28*a* is fixedly mounted in the casing 27*a*, although the mounting means are omitted from the drawing for clarity. The reservoir is provided with a charge valve and a burner valve, not shown, only the body of the latter being shown in Fig. 4, and denoted by 101*a*. A slidable nozzle 30*a* is also slidably mounted and arranged to cooperate with the burner valve as described above in the case of the nozzle 30 in Fig. 2. In the present embodiment, a flexible tube 58 made of polyvinyl chloride is connected at one end with the upper end of the nozzle 30*a* and extends therefrom to the center of the opening 56 so as to form a burner outlet 35*a* which is fixedly mounted on the upper wall of the casing 27*a*, although the mounting means are

not shown. At both sides of the upper casing wall there are fixedly mounted two substantially closed chambers 59 and 60, one of which, 59, houses therein the lamp 55 and the condensing lens 61, as shown. The other chamber 60 mounts fixedly therein the other condensing lens 62 and the photo-transistor 11*a*. An electrically heated element 26 is mounted within the interior space of the wind shield 57 directly above the burner opening 35*a*. 32*a* denotes the detector circuit including photo-transistor 11*a* shown schematically only in a block. 63 represents the current supply circuit including circuit elements 49 to 54 shown in Fig. 3.

Normally, a condensed and parallel light beam is delivered from the lamp 55 through the condensing lens 61, and through an open space between the two side chambers 59 and 60 and slightly above the wind shield and the heatable element, in the direction indicated by a horizontal arrow in Fig. 4, to the opposite condensing lens 62. The light beam falls on the photo-transistor 11*a* which is thus kept in its energized state. The output current from the photo-transistor is delivered, after being amplified, to the relay 22*a* keeping the relay contact in its open position, as has already been described.

When a person brings a cigarette or like body near to the heatable element 26 to be ignited the light beam emanating from the light source 55 and projecting onto the photo-transistor 11*a* is considerably reduced or completely interrupted. The output current from the photo-transistor 11*a* will be correspondingly reduced, whereby the actuating relay 22*a* is de-energized causing its contact to close. Under energization of the lighter-operating circuit in this way, an electromagnet 23*a* Fig. 4, arranged to function in a manner similar to the magnet denoted by 23 in Figs. 1 and 2, is energized so as to attract the free end of a conventional resilient valve-operating lever 64, the opposite end of which is fixedly attached to the slidable nozzle 30*a*. Upon the attraction as above-mentioned, the end of the lever 64 with the nozzle is raised upwards opening the burner valve so that a gas jet from the nozzle is established and maintained. At the same time, or with a short time lag or lead, the heating circuit including the heating element 26 is energized so as to heat-up the latter to a pre-selected ignition temperature so that the gas jet is ignited, thus forming a burning flame. After ignition of the cigarette, it is naturally carried away by the user, thus, there is then no body reducing or interrupting passage of the light beam onto the photo-transistor 11*a* and all the circuit elements return to their normal condition so that flow of the gaseous fuel and the heating-up of the heatable element are stopped.

In Fig. 5a, a standard igniter circuit including the heatable, electric resistance element 26 is schematically and separately illustrated. From the foregoing description, when considering the reference numerals in coincidence with those given in Figs. 1 and 2, the nature and function of this circuit may be easily understood.

In the modified igniter circuit shown in Fig. 5*b*, a pair of discharge electrodes 26*a* are employed instead the heatable resistor 26. This circuit, in effect, comprises a current source 25*a*, a condenser 65, a safety resistor 66 and a switch 67. When the switch 67, which may be arranged to be operated in the same manner as the relay contact of relay 22 or 22*a* is operated, a voltage as high as 10,000 volts is induced in a spark coil 69 which is electromagnetically coupled with a primary coil 68, one end of which is electrically connected to an intermediate point between condenser 65 and resistor 66, while the opposite end is connected with a normally opened stationary contact of the switch 67. It will be clear, that when the switch is transferred in the aforementioned manner from the position shown to the last-mentioned stationary contact, ignition sparks develop between the discharge electrodes 26*a* to ignite the gas jet.

In a modified arrangement shown in Fig. 6, a commercial current source is utilized, and a musical box, or alternatively a miniature magnetic tape recording and playback machine, shown schematically in a rectangular block 72 is employed. In order to visually demonstrate the initiation and termination of operation of the lighter-operating circuit, and to attain colour signal effects, a plurality of lamps 79 are provided and are controlled by the operating circuit. Relay 22*b* similar to 22 or 22*a*, power supply transformer 49, detector circuit 32 and a bridge comprising four rectifier elements 50, 51, 52 and 53 are also provided.

The circuit further comprises four rectifier elements 74—77 arranged in a bridge, a valve-operating device 78, and a relay contact 103 controllable by relay 22*b* in a lighter-operating circuit. The musical box 72 or magnetic tape recorder in place thereof, is operated by a D.C. motor 71 directly coupled therewith, which motor is arranged to be fed current from the secondary winding 105 of transformer 49 through a rectifier 70, when relay contact 73 is actuated by the relay 22*b*.

Coloured lamps 79 are energised from the primary side of the transformer 49 and are controlled by a switch 80 actuable under the control of the relay coil 22*b*. Thus, in this embodiment, initiation as well as termination of operation of the lighter may be clearly and amusingly demonstrated by musical as well as color signal information to the user of the lighter.

In a further modified lighter circuit sche-

matically illustrated in Fig. 7, the circuit arrangement is slightly altered, yet achieves similar results as before. The circuit elements are denoted with same reference symbols as before, so that any person skilled in the art may easily understand the nature and function of the present modification when reading through the foregoing detailed description of foregoing various embodiments.

WHAT I CLAIM IS:—

1. A gas lighter comprising a liquefied gas fuel reservoir a burner nozzle connected with said reservoir, an electric heater or spark electrodes mounted in the proximity of the outlet opening of said nozzle, means for closing and opening said nozzle to prevent or allow flow of fuel therethrough, a detector electrically connected with a detector circuit for sensing a foreign body such as a cigarette when it is brought to a position in close proximity to said detector, and an operating circuit electrically connected with said detector circuit for opening said nozzle when said detector circuit is influenced in the manner above described.

2. A gas lighter as claimed in claim 1, wherein said detector comprises part of a capacitance connected in the detector circuit.

3. A gas lighter as claimed in claim 1, wherein said detector comprises a light source and a photoelectric conversion means arranged to receive light emanating from said source.

4. A gas lighter as claimed in claim 1 or claim 2, wherein said detector circuit is a capacitor-influenced, high frequency resonance oscillator circuit.

5. A gas lighter as claimed in any preceding claim, wherein said operating circuit for closing and opening said nozzle is a solenoid circuit electromechanically connected with said nozzle.

6. A gas lighter as claimed in any preceding claim, further comprising a musical box and a drive motor directly coupled therewith, said motor being connected electrically with said detector circuit and controlled thereby.

7. A gas lighter as claimed in any preceding claim, further comprising a plurality of coloured signal lamps electrically connected with said detector circuit and controlled thereby.

8. A gas lighter as claimed in claim 6, wherein a miniature tape recorder is provided in place of said musical box.

9. A gas lighter constructed and arranged substantially as described hereinbefore with reference to and as illustrated in Figs. 1 and 2; Figs. 3 and 4; Fig. 6; or Fig. 7 of the accompanying drawings.

For the Applicant(s):
BARLOW, GILLETT & PERCIVAL,
Chartered Patent Agents,
94 Market Street, Manchester, 1.
and
20 Tooks Court, Cursitor Street,
London, E.C.4.

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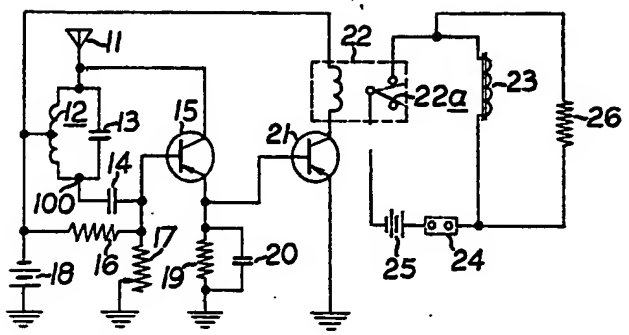


Fig. 1.

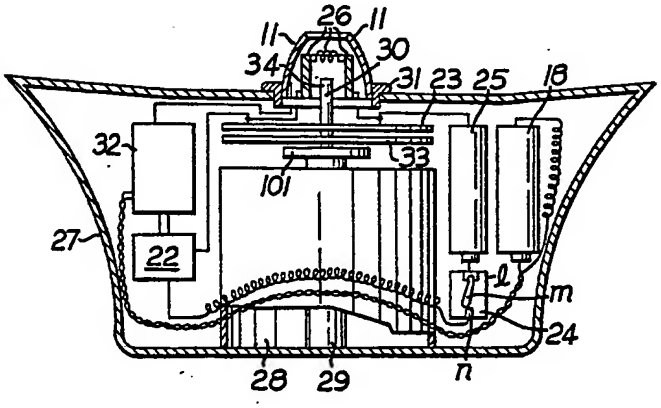
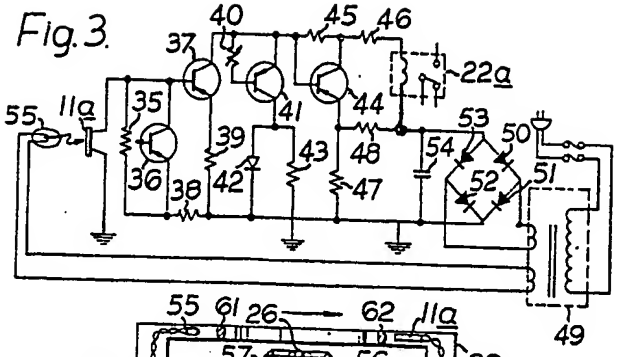


Fig. 2.

Fig. 3.



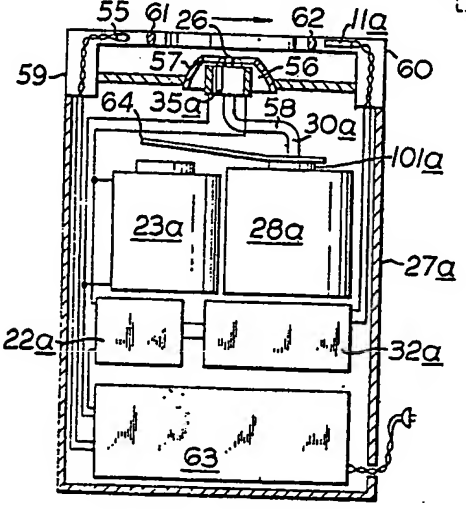


Fig. 4.

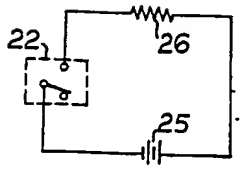


Fig. 5a.

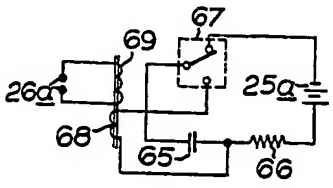


Fig. 5b.

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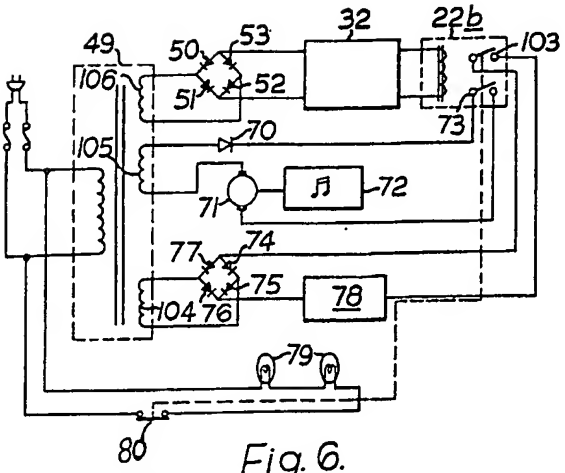

Fig. 6.

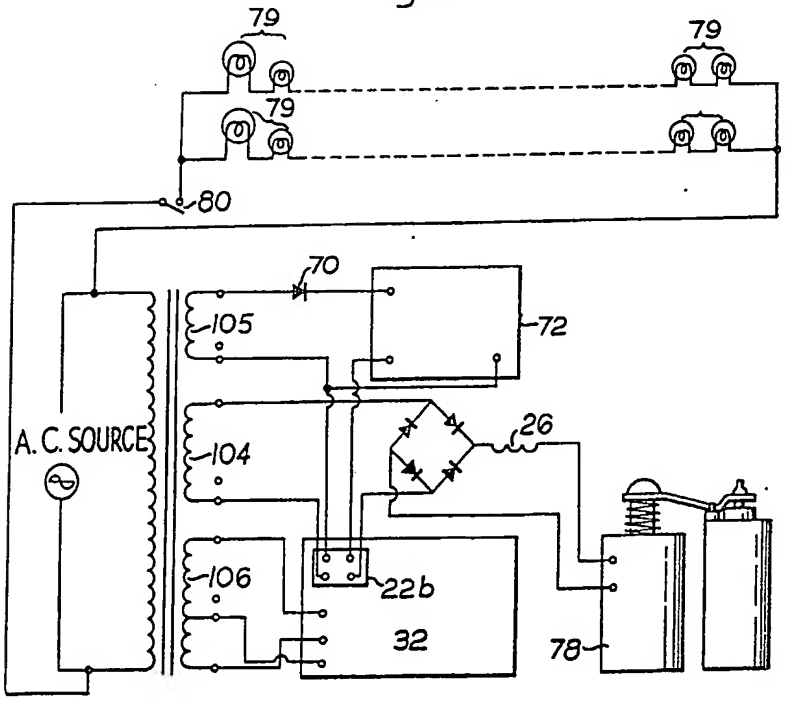

Fig. 7.

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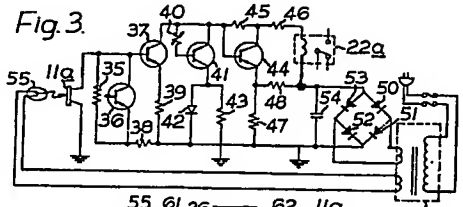
Fig. 3.



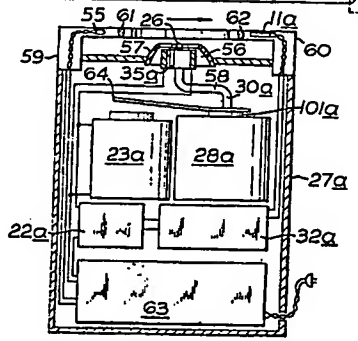


Fig. 4.

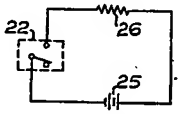


Fig. 5a.

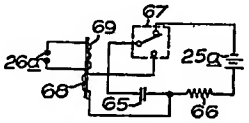


Fig. 5b.

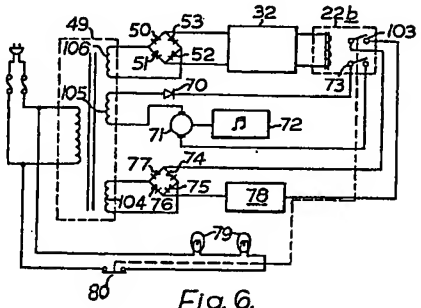


Fig. 6.

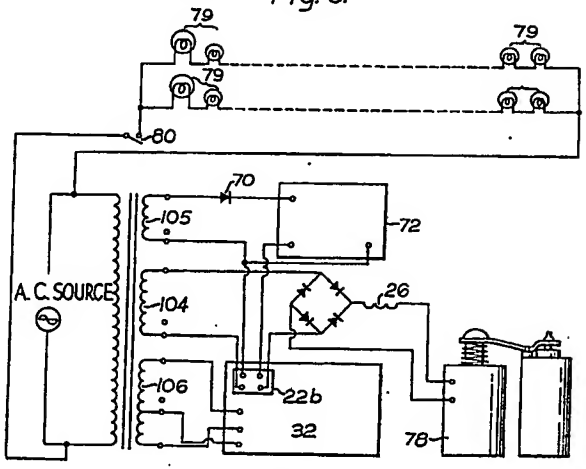


Fig. 7.